भारतीय मानक
Indian Standard

IS 9304 : 2022

आमों के भण्डारण और पकाने के लिए मार्गदर्शिका

(पहला पुनरीक्षण)

Guide for Storage and Ripening of Mangoes

(First Revision)

ICS 67.080.10

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April 2022 **Price Group 4**

Fruits, Vegetables and Allied Products Sectional Committee, FAD 10

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Fruits, Vegetables and Allied Products Sectional Committee had been approved by the Food and Agriculture Division Council.

Mango (*Mungifera indica* L.) is the native of Indo-Burma region and innumerable varieties of mangoes are cultivated. It is a seasonal crop and is highly perishable. Fruits picked at proper stage of maturity can be kept in fresh state for a few days only, under normal conditions. It is, therefore, necessary that fruits should be preserved under proper conditions so as to prolong their life for fresh consumption and processing.

This standard was first published in 1979, for which assistance had been drawn from the then ISO Draft International Standard on the subject. The first revision of this standard is being brought out to align the conditions of storage with those prevailing in Indian scenario. Some introductory conditions of ripening have also been incorporated in the standard and hence the title of the standard has been modified accordingly.

This Indian Standard provides guidance on storage and ripening of mangoes, however, because of the variability of the product according to the time and place of cultivation, local conditions may make it necessary to define other conditions for harvesting or other physical conditions in the store.

The application of the guidelines contained in this Indian Standard should enable much wastage in storage to be avoided and thus should enable long-term storage to be achieved in most cases.

The composition of the Committee responsible for the formulation of this standard is given at Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

GUIDE FOR STORAGE AND RIPENING OF MANGOES

(First Revision)

1 SCOPE

This standard describes methods for obtaining conditions for the successful storage of important varieties of mangoes (*Mangifera indica* L.) for table purposes and for processing them into various mango products.

2 TERMINOLOGY

2.1 Gray — Gray (Gy) is the unit of absorbed radiation dose. 1 Gy is equal to 1 Joule of energy/kg of material being irradiated.

2.2 D min — It is the minimum absorbed dose received by the food samples when subjected to radiation treatment.

3 CONDITIONS FOR HARVESTING AND PUTTING INTO STORAGE

3.1 Maturity

It is very important to harvest mangoes at right stage of maturity at right time with right method of harvesting to have better quality and storability.

Maximum fruit quality is attained when the fruits are harvested at optimum stage of maturity as immature fruits develop into inferior quality after ripening. Mangoes should be harvested at mature green stage, which can be judged by following (Fig. 1):

a) Fully developed cheeks with outgrown shoulders and prominent pit at the stalk end;
b) Change in skin colour from dark-green to light-green;
c) Visibility of lenticels;
d) When the spurt of sap exudation from the cut end of stalk is very less;
e) Change in flesh colour from white to yellowish; and
f) When specific gravity is more than 1.0 (Alphonso, Kesar, Langra, Raspuri).

The quality of Alphonso fruits after ripening will be very good when the fruits are harvested at a specific gravity of 1.01 to 1.02.

3.2 Method of Harvesting

If harvesting is not done properly it will injure the fruits which may be visible or not, but this injury becomes entry point for microorganisms causing spoilage during storage and ripening. So, mangoes should be harvested properly either by hand (small trees) or using harvesters (big trees) (Fig. 2). It is always better to harvest with stalk so as to avoid the sap being fallen on fruit surface. Harvested fruits should be placed in clean plastic crates and kept under shade till they are transported.

3.2.1 *Pre-storage Operations*

3.2.1.1 *Sorting*

Sorting has to be carried out to remove immature, undersized, damaged, bruised, scarred, misshapen or ripe fruit. Diseased and infected fruits should be removed to avoid spread of decay during storage

3.2.1.2 *De-sapping*

The sap if fallen on the fruit surface causes sap-injury/sap-burn. After harvest, the sap should be allowed to drain away from the fruit by placing the fruits in inverted position. Clip the stems short (1 cm), while holding the fruit with stem end down. Place the fruit on de-sapping bench or specially knitted pallets as shown in Fig. 3 and allow them to drain for 20 to 30 min until the sap flow is stopped. In the modern pack-houses de-sapping conveyor belts are used for de-sapping purpose.

3.2.1.3 *Washing*

Fruits are to be washed properly to remove any latex stains, spray residues, sooty molds, etc. with clean water. Sodium hypochlorite at the rate of 100 ppm can be added to the wash water. Washed fruits should be air dried thoroughly to remove surface moisture before keeping for storage. Under automated systems, the fruit passes under a spray washer and onto a moving conveyor belt for hot air drying (Fig. 4).

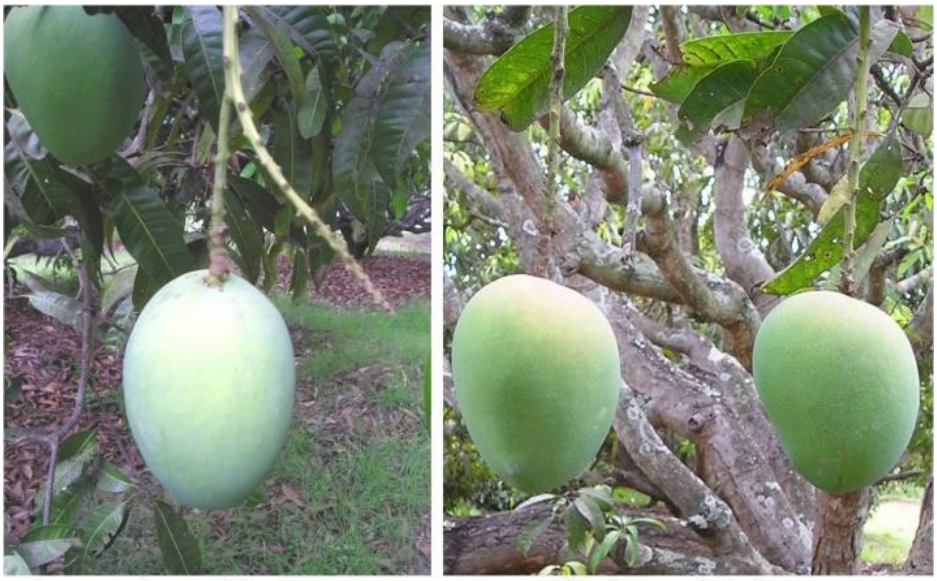

Fig. 1 Immature Alphonso Mature Alphonso

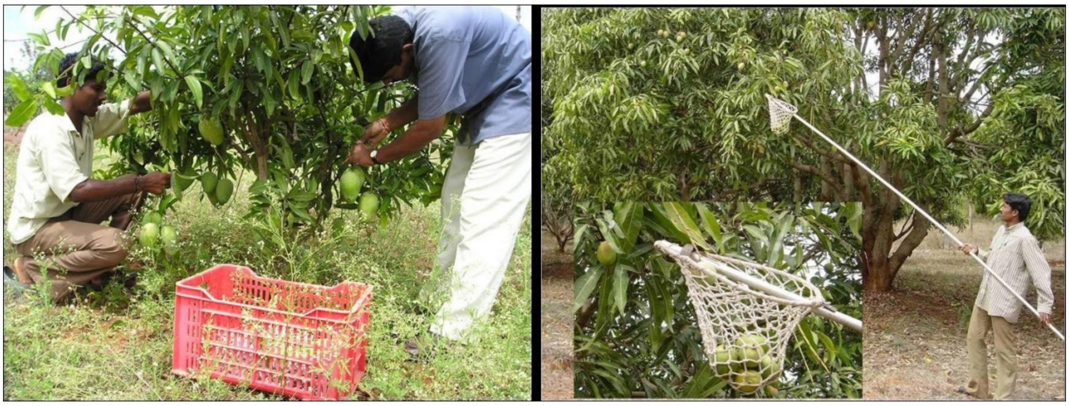

Fig. 2 Harvesting by Hand Picking Harvesting Using Mango Harvesters

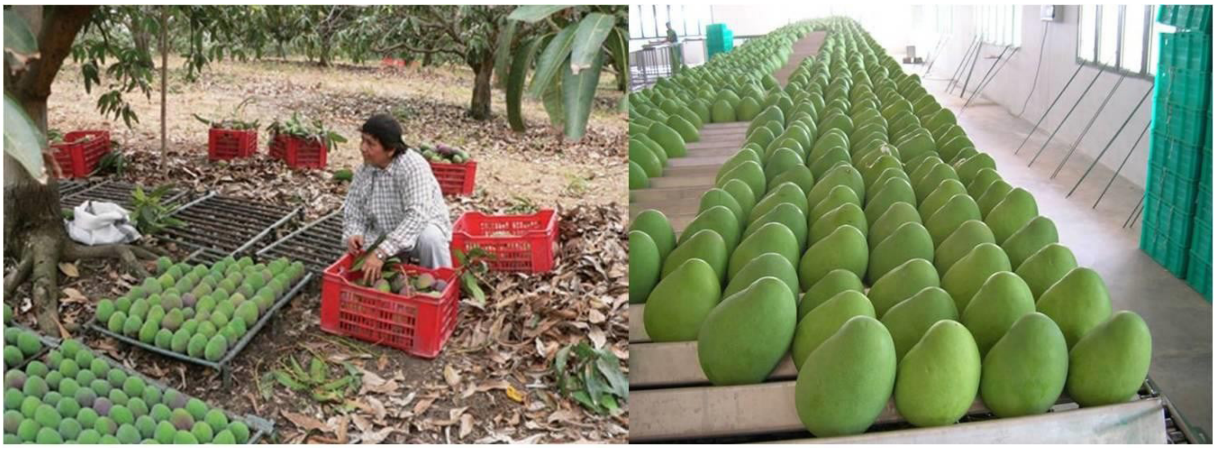

Fig. 3 De-Sapping Benches De-Sapping Conveyors

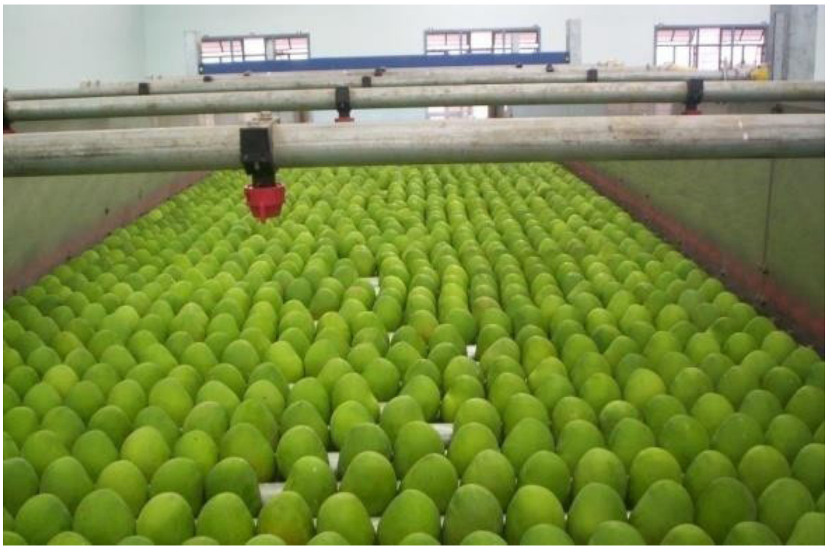

FIG. 4 AUTOMATIC WASHING OF MANGOES

3.2.2 *Hot water treatment before storage*

Mangoes harvested from areas or trees known to suffer from anthracnose, can be subjected to hot water treatment (52-55 °C for 5 to 10 min, depending on the variety and size). This treatment helps to control anthracnose and stem end rot during ripening and storage.

3.3 Quarantine Treatments

Different countries demand different disinfestation treatments against mango fruit fly and or stone weevil as a quarantine treatment for export purpose.

a) Mangoes should be treated in hot water at 48 °C for one hour as a disinfestations treatment against fruit fly. After hot water treatment the fruits should be cool rapidly and surface dried before packing (Fig. 5).

b) For control of quarantine pests (fruit fly), Vapor Heat Treatment (VHT) system that uses heat saturated water vapour is used. During VHT treatment fruit pulp core temperature is maintained at 47.5 ºC for a minimum of 20 min.

c) Mangoes may be irradiated with a D min. of 400 Grays at the approved and certified irradiation treatment facility. Irradiation treatment is approved for control of both fruit fly and seed/ stone weevil infestation. The radiation dose used are within the window of approved dose range for Fresh Fruits and Vegetables (Class 2) as per the Rules and Regulations framed under *Food Safety and Standards Act 2006*.

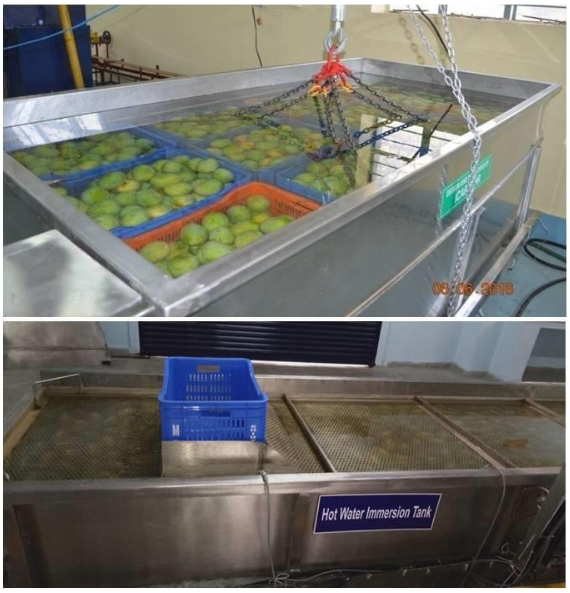

FIG.5 QUARANTINE HOT WATER TREATMENT

3.4 Storage

Fruits should be stored as soon as possible after harvesting. Only good quality fruits should be kept for storage. The fruits should be packed properly before putting into storage rooms. Fruits can be placed in ventilated plastic crates of 20-25 kg capacity or in 5 ply corrugated fiberboard (CFB) boxes. Cartons must not be over-filled and typical carton external dimensions for holding 4 kg mango fruits are 40 × 30 × 10 cm (length × width × height). At ambient temperature the storage life of mangoes is limited to 7-12 days depending on the variety and maturity. However at an optimum temperature of 13 °C and 85-95 percent relative humidity, mango can be stored for about 20-25 days.

3.4.1 *Pre-cooling*

As mangoes are harvested during summer season with more field heat, it is advisable to pre-cool them faster before putting into cold rooms. Pre-cooling is usually done by more efficient forced air cooling method. Mangoes should be pre cooled to 13 °C (the recommended storage temperature) by placing the fruits in pre-cooler room where temperature is set at 13 °C with 90 to 95 percent RH.

4 OPTIMUM STORAGE CONDITIONS

After precooling the fruits should be immediately shifted to cold rooms set at 13 °C and 85-95 percent RH. At storage temperature below 13 °C, mangoes are susceptible to chilling injury that cause discoloration of the skin, pitting and uneven ripening when shifted to ambient conditions with increase susceptibility to decay. At optimum temperature mangoes can be stored up to 3 weeks. Strict levels of initial quality control for fruit stored at low temperatures are essential because blemishes, bruises, damage, and infections will manifest to a greater degree under ideal low temperature conditions.

The crates or boxes should be staked and arranged in the cold room in a manner so as to permit free circulation of air. The storage density between 200 and 250 kg per cubic meter of usable space is considered suitable. The use of palletization may increase the storage density and facilitate easy handling while loading and unloading from the cold rooms. The pictures of some modular cold rooms are given at Fig. 6.

5 RIPENING

5.1 Natural Ripening

Traditionally, mature mangoes are ripened naturally by covering the heap with paddy straw (Fig. 7) or by individually wrapping the fruits with newspaper. Ethylene gas is released from the fruits in due course of time that helps in ripening of fruits. Use clean straw every time to avoid spread of rotting. The height of the heap should be less so as to avoid the crushing and spoilage of bottom layer of fruits once they are ripened.

5.2 Permitted Artificial Ripening

Natural ripening of mangoes is a bit slow leading to high weight loss, shriveling and in some cases uneven ripening. To enhance ripening, ethylene in the form of gas [as permitted by Food Safety and Standards Authority of India (FSSAI)] can be sourced from commercial ethylene gas cylinders or small canisters or produced by ethylene generators. Mangoes should be exposed to the ethylene gas in air-tight chamber/plastic tent for 24 h with the concentration of the gas about 100 ppm (Fig. 8).

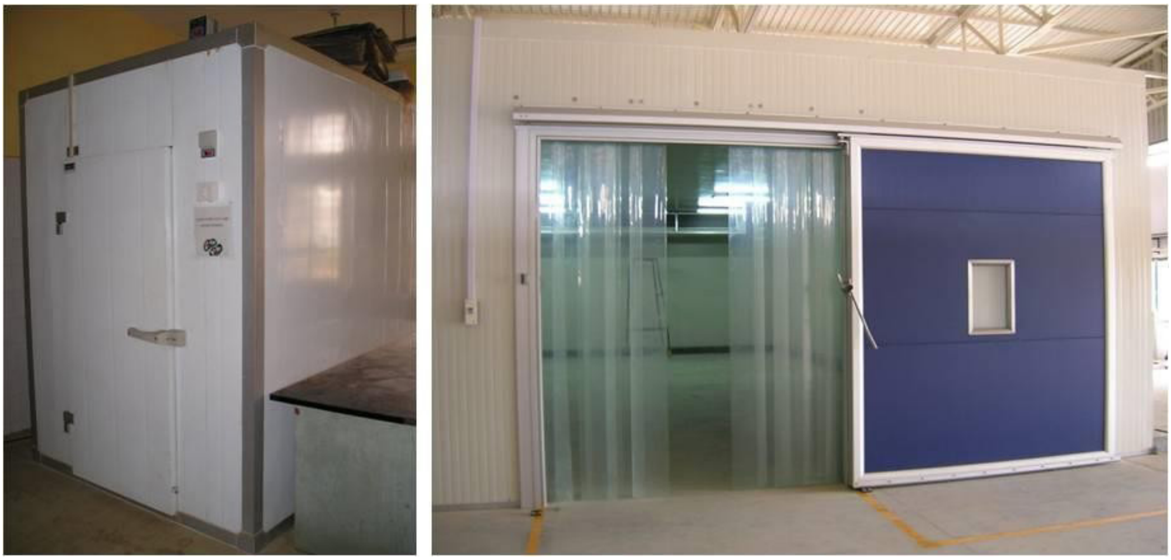

FIG. 6 MODULAR COLD ROOMS

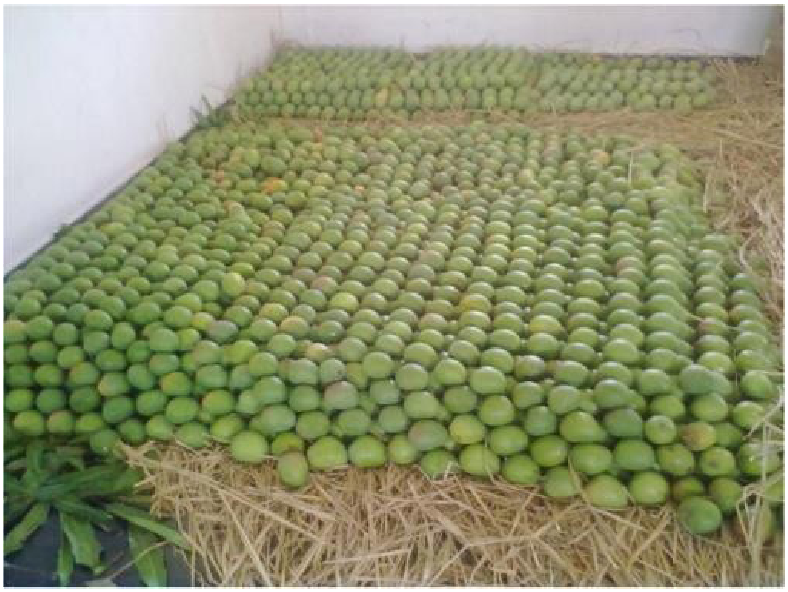

Fig. 7 Natural Ripening

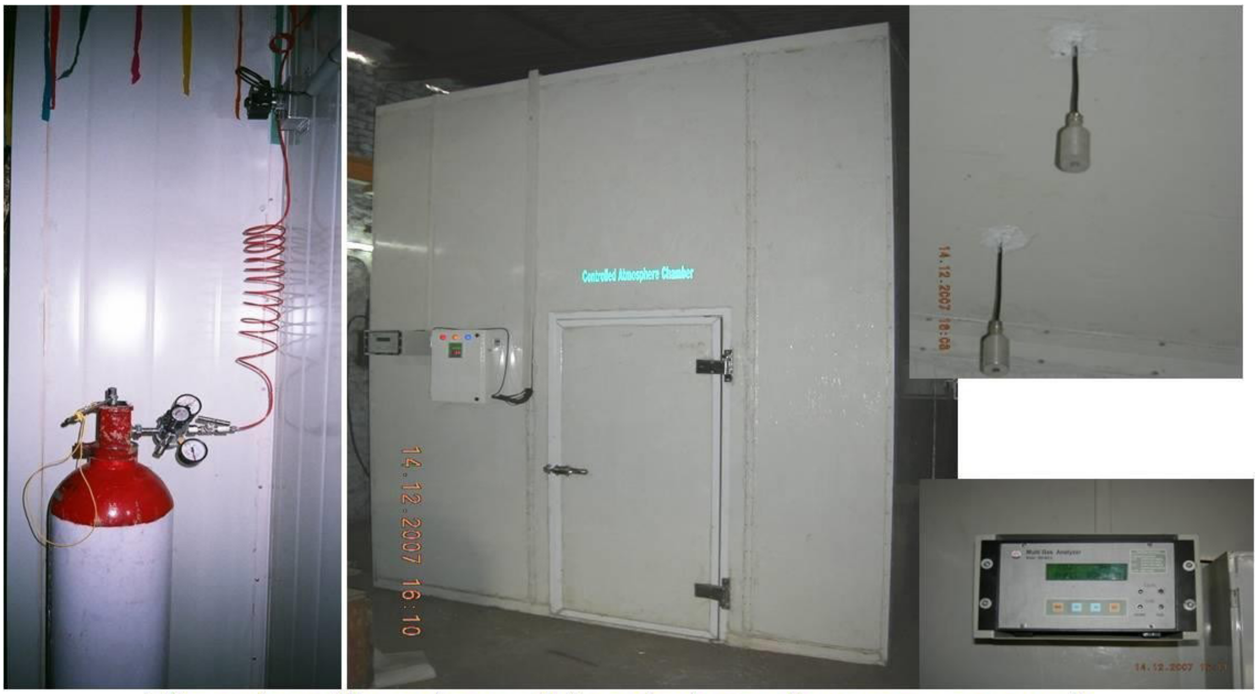

Fig. 8 Ripening Chamber With Ethylene Gas

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Fruits, Vegetables, and Allied Products Sectional Committee, FAD 10

Organization	*Representative(s)*
ICAR-Indian Institute of Horticultural Research, Bengaluru	Dr M. R. Dinesh (***Chairman***)
All India Food Processors Association, New Delhi	Dr R. K. Bansal Shrimati Mamta Arora (*Alternate*)
Association of Food Scientists and Technologists India, Mumbai	Dr Revathy Baskaran Dr K. V. Harish Prashanth (*Alternate*)
CSIR-Central Food Technological Research Institute, Mysore	Dr P. Vijayanand Dr A. S. Chauhan (*Alternate*)
College of Agricultural Engineering Post-Harvest Technology, Gangtok	Dr Sujata Jena Dr Said Prashant Pandharinath (*Alternate*)
Confederation of Indian Food Trade and Industry, New Delhi	Shrimati Priyanka Sharma (*Alternate*)
Consumer Guidance Society of India, Mumbai	Dr Sitaram Dixit Dr M. S. Kamath (*Alternate*)
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ICAR-Central Institute of Agricultural Engineering, Bhopal	Dr C. R. Mehta Dr M. K. Tripathi (*Alternate*)
ICAR-Indian Institute of Horticultural Research, Bengaluru	Dr R. B. Tiwari Dr D. V. Sudhakar Rao (*Alternate*)
ICAR-Central Institute for Subtropical Horticulture, Lucknow	Dr Neelima Garg
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Organization	*Representative(s)*
In Personal Capacity (*CD 223, Ansal Golf Link I, Greater Noida*)	Shri Pitam Chandra
BIS Directorate General	Shrimati Suneeti Toteja ,Scientist 'E' and Head (FAD) [Representing Director General (*Ex-officio*)]

Member Secretary

Shrimati Varsha Gupta
Scientist 'D' (FAD), BIS

Panel for Review of Indian Standards Related to Storage, Transport and Ripening of Fresh Fruits and Vegetables, FAD 10 : Panel 2

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Bhabha Atomic Research Centre, Mumbai	Dr Satyendra Gautam
ICAR-Indian Institute of Horticulture Research, Bengaluru	Dr D. V. Sudhakar Rao
ICAR-Central Institute for Subtropical Horticulture, Lucknow	Dr Bharati Killadi
Warehousing Development and Regulatory Authority, New Delhi	Shri Vinay Kumar Chauhan

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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